Project Title: "Source Control by Hydrogeological Isolation: Application of the Ankeny Moat"

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Collaborators: Oklahoma Corporation Commission, Petroleum Storage Tank Division

Introduction to the problem: Complete source removal of petroleum spills is virtually impossible, leaving residual BTEX to contaminate the ground water. Isolating the petroleum residuals with a drainage system surrounding the source zone to control the flow of ground water around the source and protect the water's purity.

Background: Residuals from a diesel spill at a gas station has been releasing BTEX into the ground water for a number of years. The site has a shallow perched aquifer separated from a deeper aquifer by a clay layer. The ground water flows from the northwest through the site towards a creek a half mile away.

Objectives: 1) Characterize the site hydrology and soil composition. 2) Design a moat, a drainage system of interconnected French drains, to reduce the water flow through the source zone by completely surrounding the source zone. 3) Monitor and assess the resulting change in the hydraulic gradient and geochemical properties of the site after the moat is installed.

Approach: Use hydraulic conductivity and electrical conductivity tests characterize the soil profile of the site. Measure water levels to determine the hydraulic gradient and direction through the site. Utilize the site data and surface traffic patters to design the depths, high hydraulic conductivity regions, and locations of a series of interconnected French drains (Figure 1). Each drain line will be made of porous polyethylene pipe with an average pore size of 40 microns. Use lateral drilling to install the lines without have to dig a trench and disrupt the normal functions of the station. A pilot hole will be drilled and the drain, encased inside a reusable outer sheath will be pulled back through the hole. The drain will then be anchored while the sheath is pulled out of the ground. Intersecting drain lines will be connected in pits dug where the drains overlap. Risers were installed at the three connection points to allow for measurement of constituents within the different sections of the moat. These measurements will allow establishment of hydraulic connectivity within the moat. Water levels and site geochemistry will be measured regularly to determine the effect of the moat, connected series of drain lines, on the hydraulic gradient of the site to verify that the ground water flow through the source zone is reduced. Determine if the moat is delivering nutrients to the down-gradient side of the moat to assist in the natural attenuation of the BTEX.

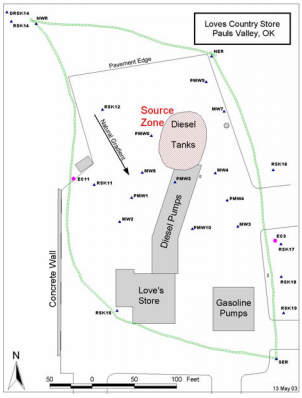


Figure 1: Site Map

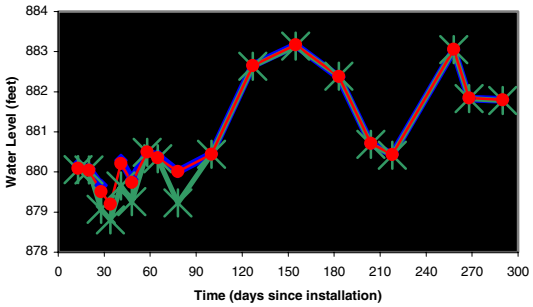
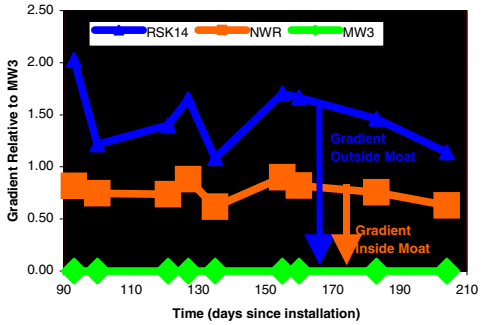


Figure 2: Riser Water Levels. blue – NWR, green – NER, and red – SER.

Accomplishments to date (24 Feb 2003): Completed the characterization of the site using hydraulic conductivity and electrical conductivity measurements. Designed the moat to be placed around the spill source zone, present diesel tank and gasoline tank pits. Had the moat installed at the bottom of the perched aquifer approximately 8 ft deep. Have conducted water level monitoring and geochemical and BTEX measurements for a year since installation. The water levels in the three risers, NWR, NER, and SER stabilized to the same level when rain raised the water table (Figure 2). The ground water flow through the source zone has been reduced by approximately 50% as seen by the reduction in the hydraulic gradient across the site (Figure 3.) The electron balance show that there are more electron acceptors, 6.64 meq/L in the southeast riser (SER) than electron donors, 3.23 meq/L, BTEX, methane, and TOC, due to the moat bringing sulfate from up-gradient. The situation immediately down gradient of the source in MW3 is reversed with 0.23 meq/L of electron acceptors and 1.35 meq/L of electron donors.



Near future tasks: Continued periodic monitoring of the water levels and sampling for the geochemical parameters and BTEX contaminants in the wells.